LONG TERM STORAGE OF GRAINS WITH GRAIN CHILLING TECHNOLOGY

Presenter: Rahul Khanna

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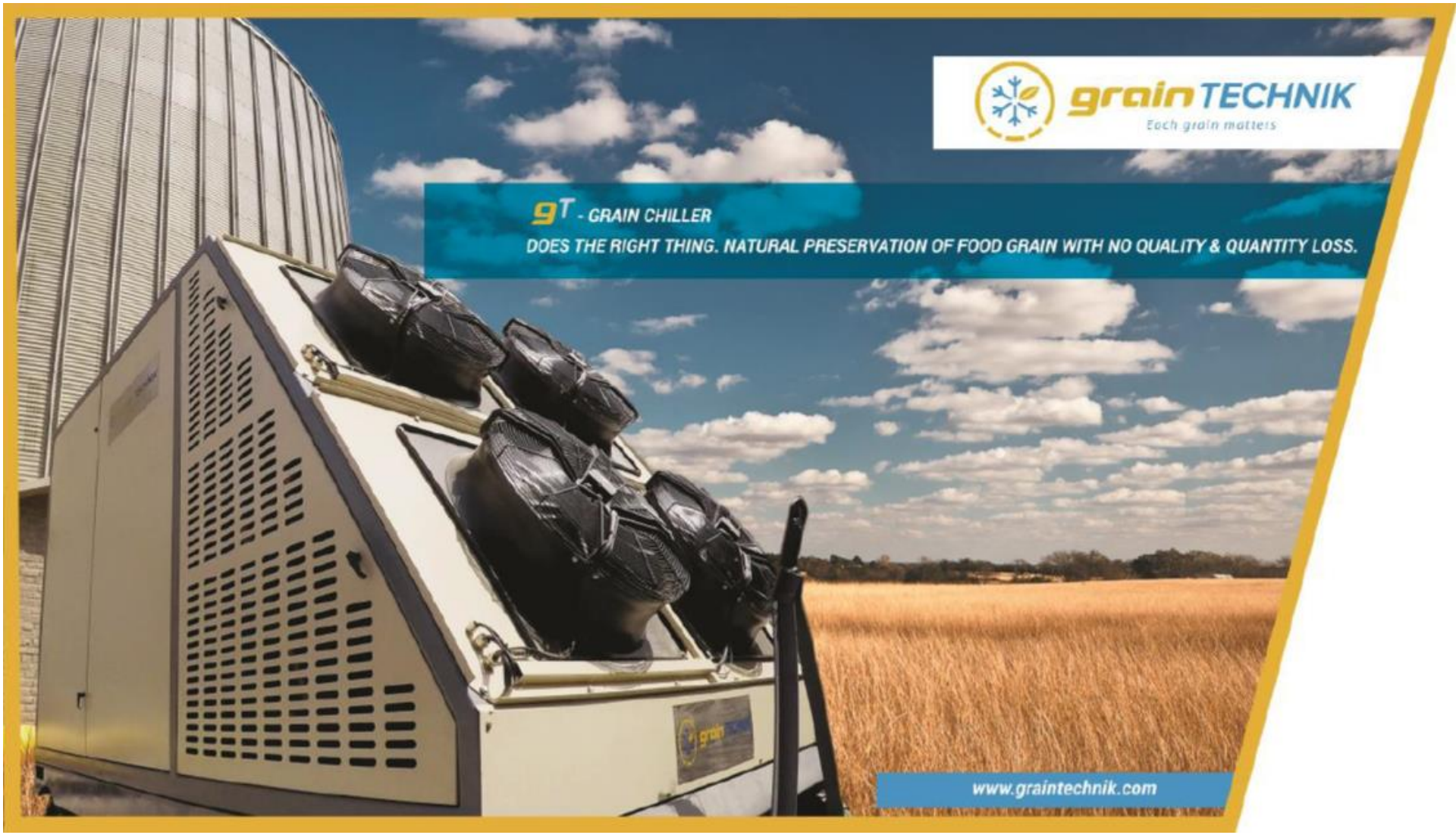
Each grain matters

MAINTAINING QUALITY OF GRAINS DURING POST HARVEST STORAGE

- CONCEPT OF GRAIN CHILLING ?
- HOW DOES A GRAIN CHILLER WORK ?
- NECESSITY OF USING A GRAIN CHILLER & ITS BENEFITS
- OPERATIONAL FEASIBILITY
- SUCCESSFUL IMPLEMENTATION OF CHILLING TECHNOLOGY
- QUESTIONS & DISCUSSIONS

CONCEPT OF GRAIN CHILLING

- Designed for providing a solution when inadequate ambient conditions don't allow long term storage of grains
- A technology using a refrigeration system to provide conditioned air into a silo / warehouse
- Keeping grains safe during storage times by maintaining precise temperatures & Relative Humidity levels
- Conceptualized since storage under 15º C can eliminate various factors leading to damage of grains



FIRST INDIGINEOUS GRAIN CHILLER

HOW DOES IT WORK ?

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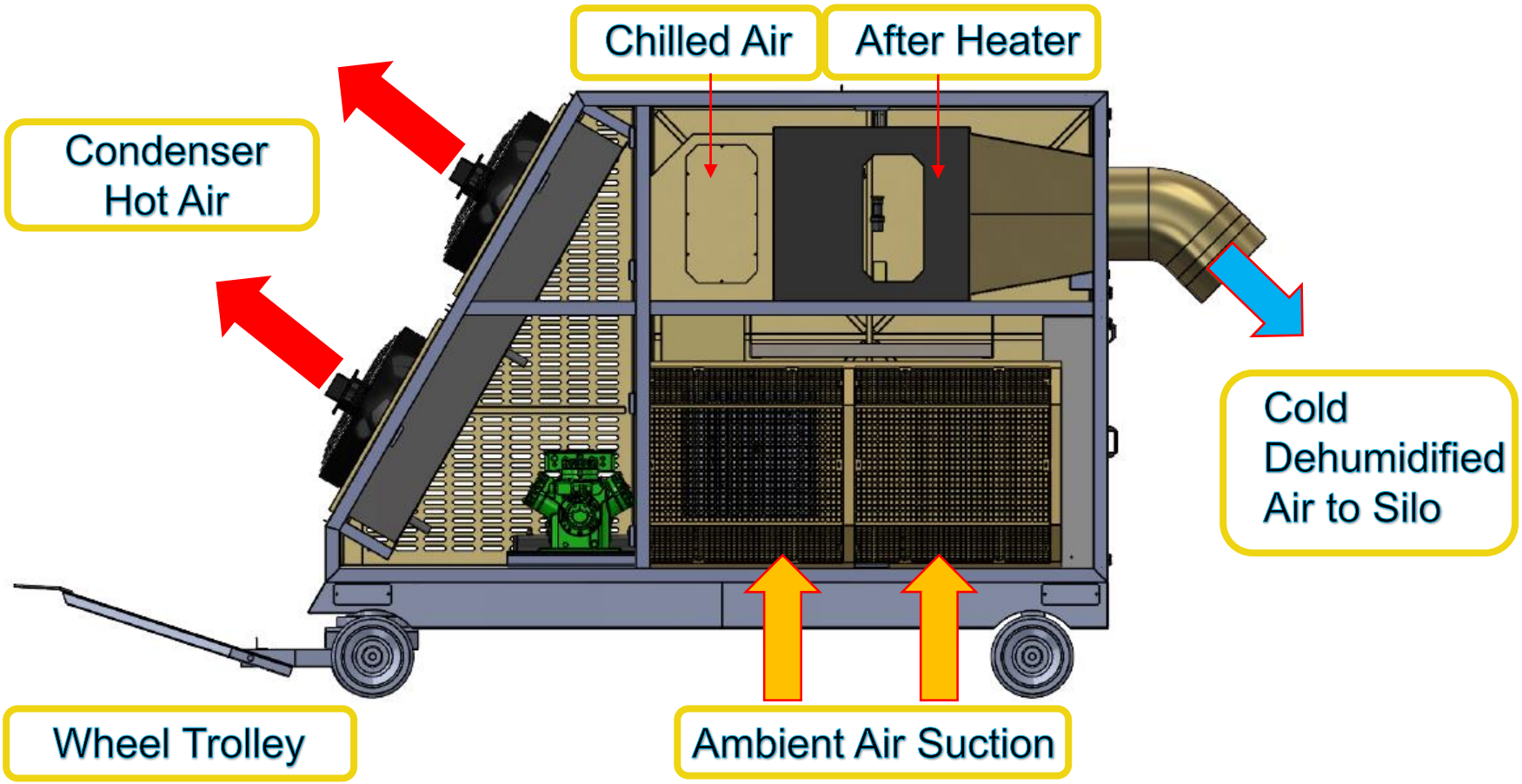

ATTACHING TO SILO

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- Can be easily integrated to an existing / new silo through Aeration Fan Opening
- Using the Aeration Channels inside silo, cold dehumidified air sent through the grain
- Hot air after heat exchange is sent out through Air Vents on silo roof

WHY GRAIN CHILLING ?

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COMMON ISSUES FACED BY MILLERS

- Weevil Infestation
- Mildew / Fungal Growth
- Dry matter loss due to grain respiration
- Loss of Protein Content
- Germination Loss
- Broken Grains
- Shrinkage due to Aeration
- Discolouration of grains

WHY GRAIN CHILLING ?

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Effect of the Hygroscopic Nature of Food Grains

They may retain, absorb or release water vapor, and excessive amounts of inherent moisture may lead to significant self-heating and "moisture migration" within the silo/warehouse/cargo resulting in baking, mildew or rot.

WHY GRAIN CHILLING ?

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IDEAL SOLUTION FOR STORAGE

AVOID BAKING/WETSPOT/DISCOLOR/FOUL SMELL/DECAY OR POWDER/WEIGHT LOSS

WHY GRAIN CHILLING ?

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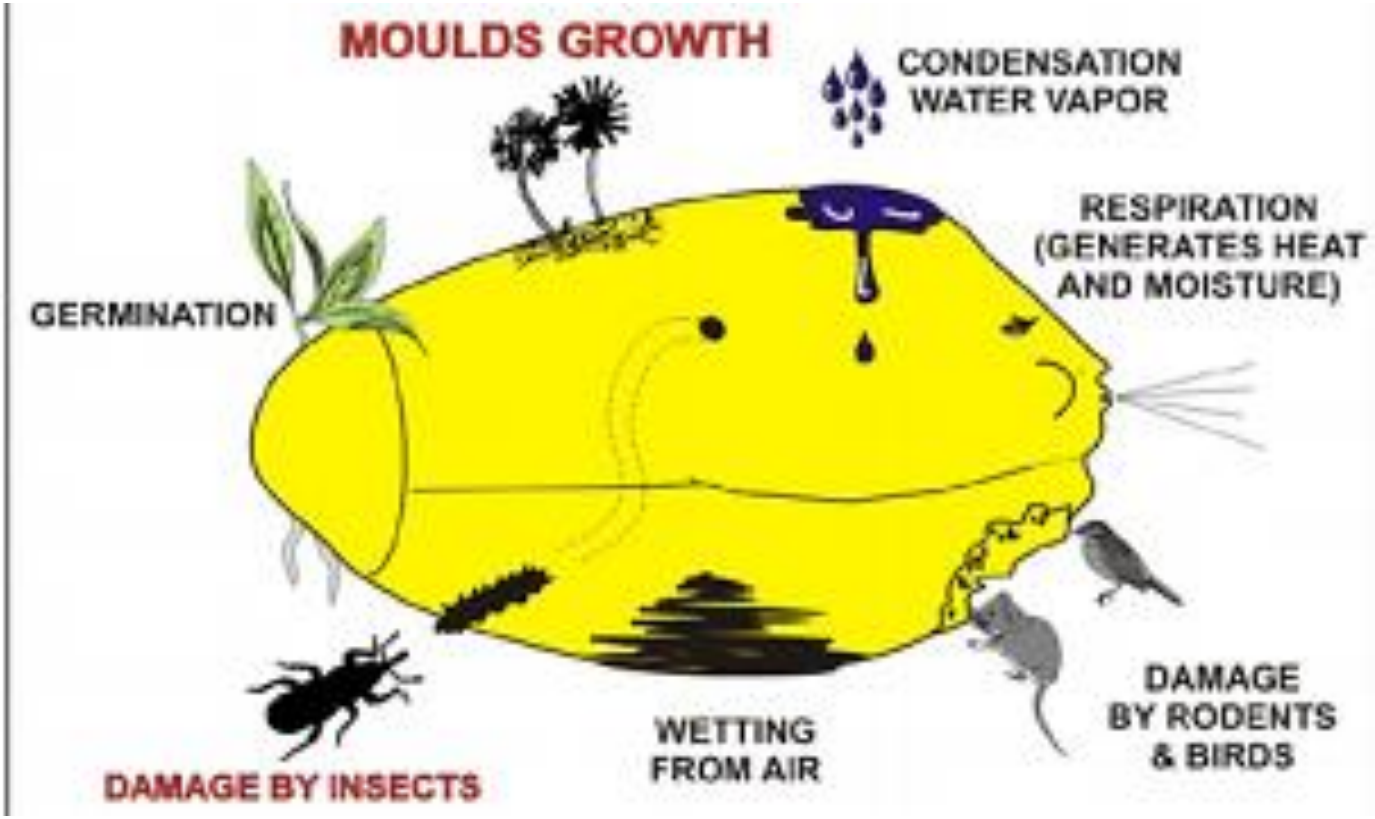
Various Risks of Quality Deterioration in the Ecosystem of Bulk Grains



Losses of Lusture

Kernels which are materially dis-colored by excessive respiration. The discoloration originates from the germ area and continues through the sides and back of the kernel.

Shrinkage

- Shrinkage is physically noticeable and attributes to financial loss in grain storage (physical weight loss due to moisture loss).
- Shrinkage causes irreversible changes to starch molecules limiting digestibility and nutrient availability.

Insect Infestation

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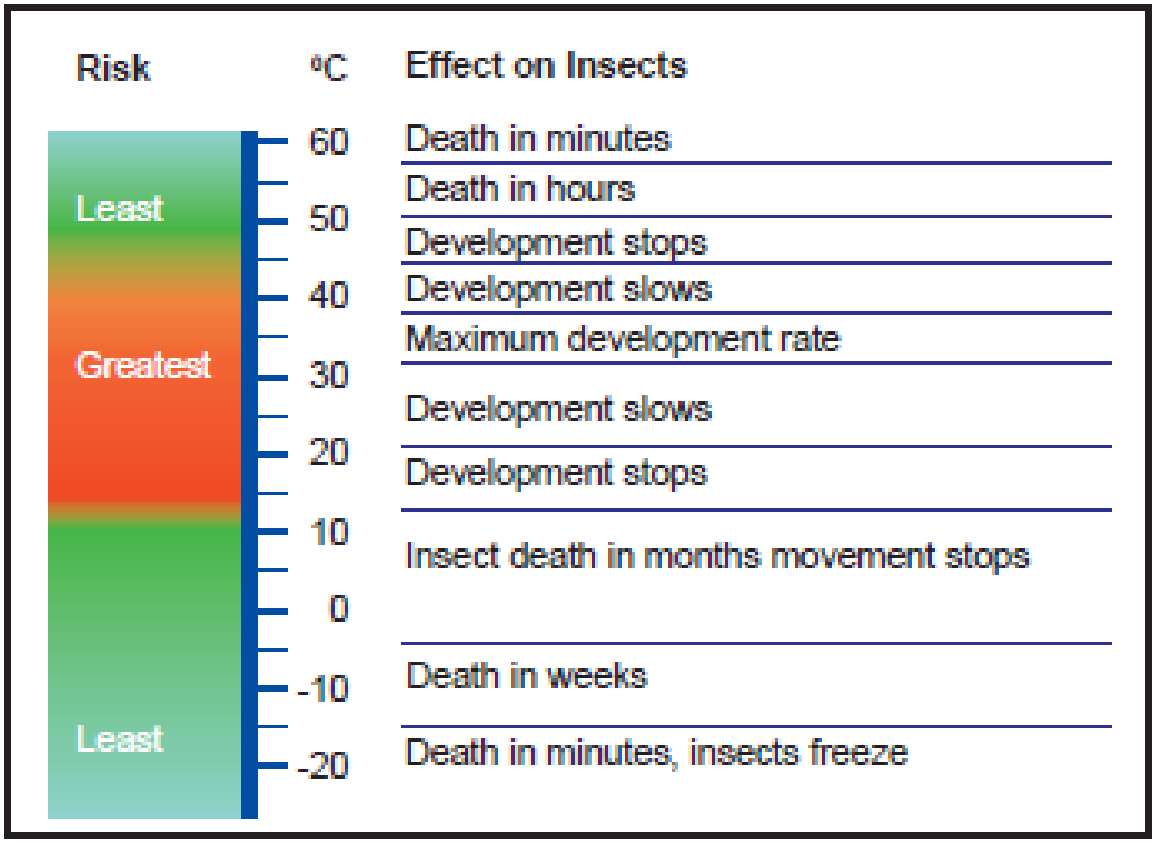
Insects Multiply at Optimal Conditions

- **Khapra Beetle**
- **Lesser Grain Borer**
- **Rice Weevil**
- **Red Flour Bettle**

Insect Infestation



Effect of different temperatures on Insect

Below 13 C no insect activity & no damage

Silo Corrosion

- Sweating and caking at side wall – visible corrosion to silo wall.

Fungus Risk

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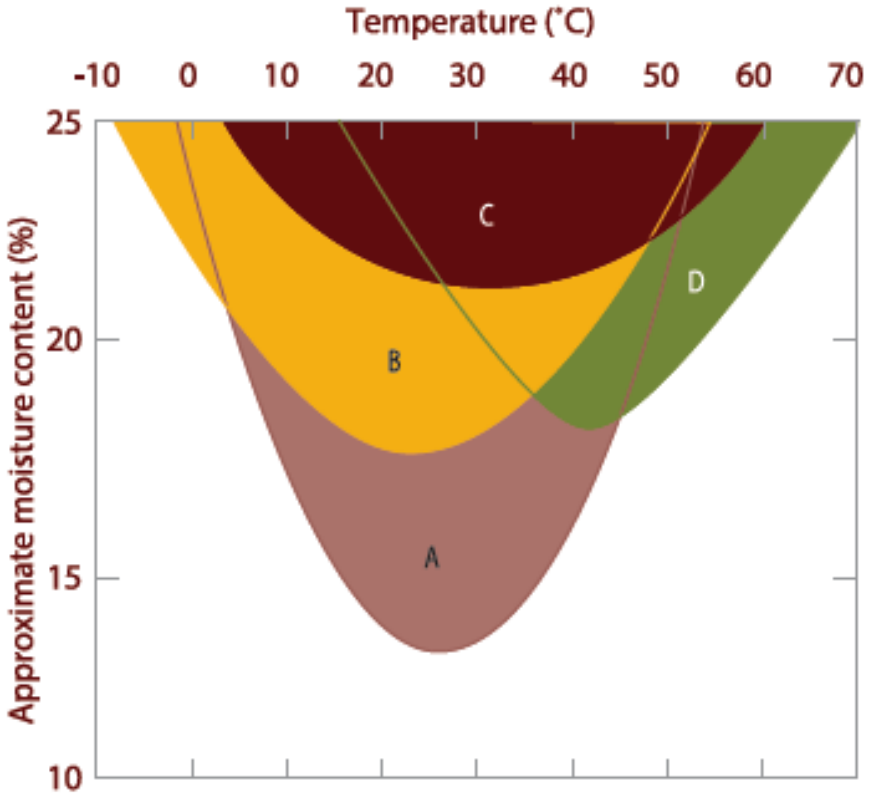
Different types of fungi thrive at different moisture contents and temperatures in stored grain

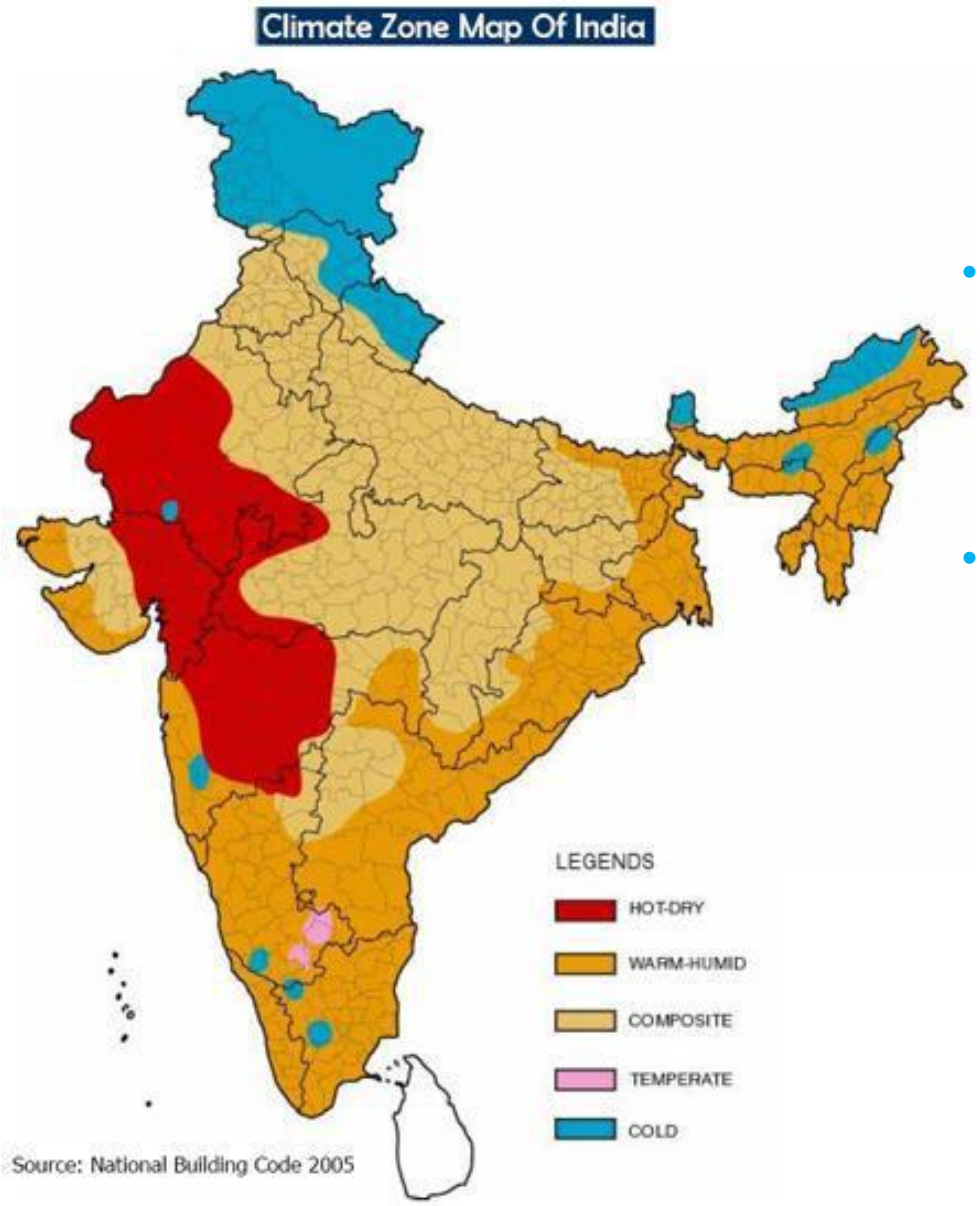


A – Aspergillus species which may damage germination and cause slow heating.

B – Penicillium species, including those that produce mycotoxins.

C – Advanced decay/field fungi, eg Fusarium species and heating organisms, eg Absidia species which may be pathogenic causing, for instance, farmers' lung.

D – Thermophilic fungi, which thrive at very high temperatures, such as those that occur in compost bins.



Inadequate Tropical Climate for Storage

- Chilling Technology proves to be an effective tool for post harvest storage in Hot & Humid Sub Continent Conditions
- Grain Chilling can supply uniform Temperature & Relative Humidity to target grain equilibrium levels

CHILLED VS NORMAL AERATION

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AERATION IS MUST BUT ONLY POSSIBLE WITH THE RIGHT TEMPERATURE & RH%

Risk when ventilating with ambient Aeration

If humid air is blown into dry grain, moisture content will increase. High amounts of moisture build-up when the air temperature is higher than the grain temperature.

No Risk with Chilled Aeration / Grain Chilling

When Chilled Air at a set specified Temperature & RH% is blown in to grain, there is no risk of Moisture Addition. Temperature is reduced & grain remains fresh

Cold Grain Remains Cold

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GRAIN CHILLER STUDY ON BINNED WHEAT

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Table 6. Flour quality analysis of wheat stored in the Chilled and Control bins from samples taken before chilling (Aug. 15th) and after chilling (Sep. 22nd).

Variables	Chilled Bin		Control Bin	
	August	September	August	September
MC Wheat (%)	10.53[a]	10.41[a]	10.39[a]	10.28[a]
Wheat Protein (%)	12.49[a]	12.40[a]	13.33[a]	12.59[a]
Flour Protein (%)	11.14[a]	10.97[a]	11.87[b]	11.27[a]
Absorption (%)	63.83[a]	64.33[a]	64.69[a]	65.33[a]
Mix Time (min)	3.73[a]	3.42[a]	3.53[b]	3.00[a]
Loaf Volume (cc)	741.08[a]	814.33[a]	818.34[b]	767.00[a]

([a,b]) Mean values with the same letter within the same bin and quality variable but at different sampling dates are not significantly different by Tukeys test ($p > 0.05$).

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Conclusion: In the Control bin there was a significant decrease in quality after 38 days storage period. It is observed that protein content decreased from 11.87% to 11.27%. Mixing time also decreased from 3.53 to 3 minutes, as well as loaf volume decreased from 818.34 cc to 767 cc.

Ref: According to Study Published by IOWA State University, USA

Operational Cost Calculation

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SAMPLE OPEX CALCULATION	
Model	GT-450
Nominal Cooling Capacity	Approx. 400 Tons per day
Silo Capacity	7500 MT
No. of Days Required for chilling grain inside silo including re-chilling	24 / 180
Total Running Hours per day	24
Total Running Hours	576 Hours
Avg Power Consumption	78 Kw
Total Units Consumed	44,928
Est. Unit Cost	8 Rs./Kwhr
Total Running Cost (Approx.)	Rs. 3,60,000/-
Total Chilling Cost per Ton	Rs. 48 / Ton
Total Price of Wheat in Silo	Rs. 12,75,00,000/-
1% Loss of Grain in Silo	Rs. 12,75,000/-
2% Loss of Grain in Silo	Rs. 25,50,000/-
3% Loss of Grain in Silo	Rs. 38,25,000/-

- Wheat Storage for 6 months during Summer & Monsoon Season
- Wheat Selling Price Estimated – Rs. 17,000 / Ton

Advantages of Chiller

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- Weather Independent
- No risk of grain spoilage for the total duration of storage
- No risk of insects
- Maintaining Alcohol Acidity in Wheat
- No risk of Fungal Growth
- No foul smell; harvest freshness is maintained
- Maintaining high germination rates
- No respiration loss
- No grain powdering
- No discoloration
- High Milling performance

GT-GRAIN CHILLER

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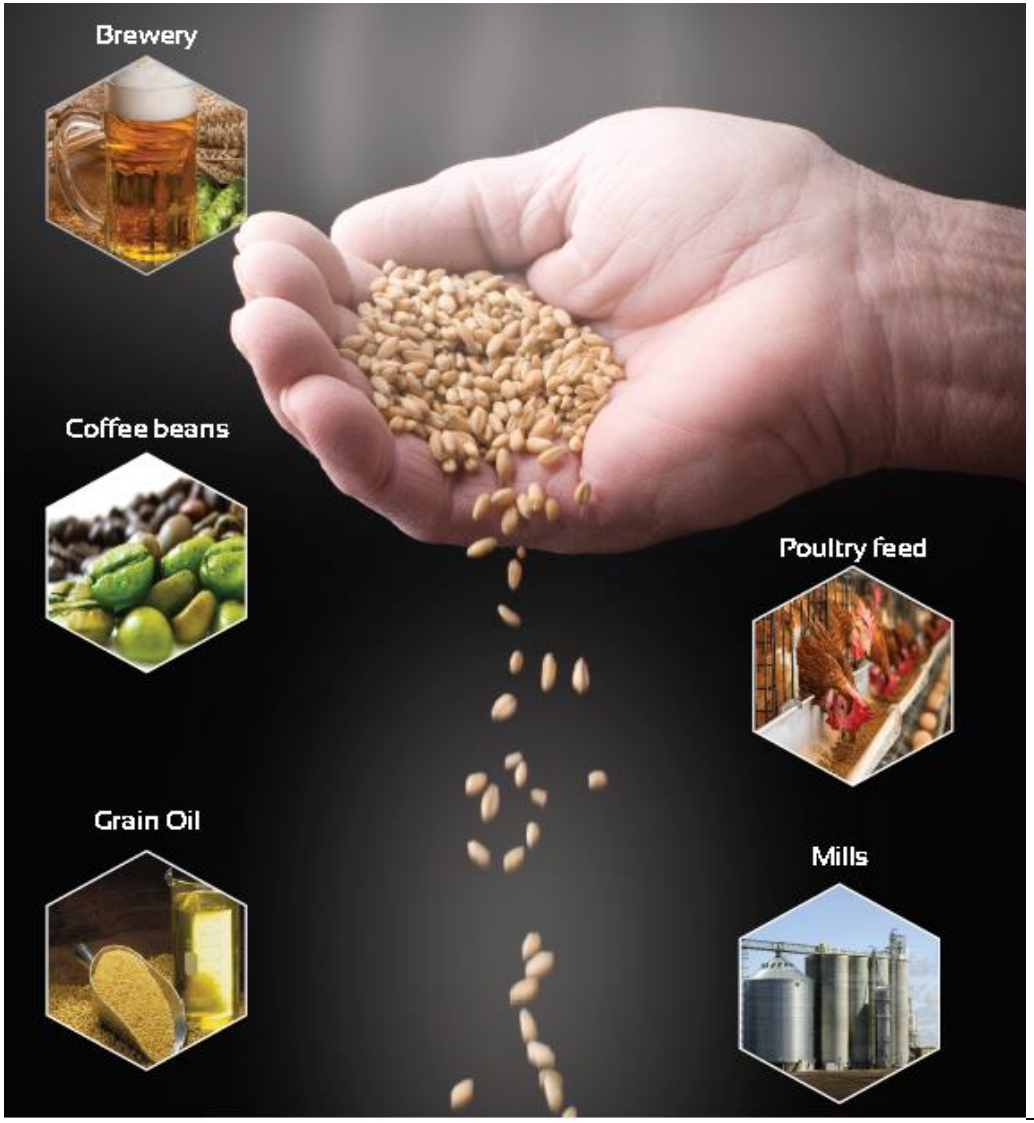

Key Applications

- Paddy
- Milled Rice
- Wheat
- Malting Barley
- Maize
- Poultry Feed
- Oil Seeds
- Peanuts
- Soya Beans
- Dal (Lentil)

SUCCESSFUL INSTALLATIONS

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NCML, Bihar – Storage of Maize

SUCCESSFUL INSTALLATIONS

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Sneha Farms, Hyderabad – Storage of Maize

Installations

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KRBL Ltd. (India Gate Basmati) – Storage of Paddy

Installations

ITC Ltd. – Storage of Wheat

Installations

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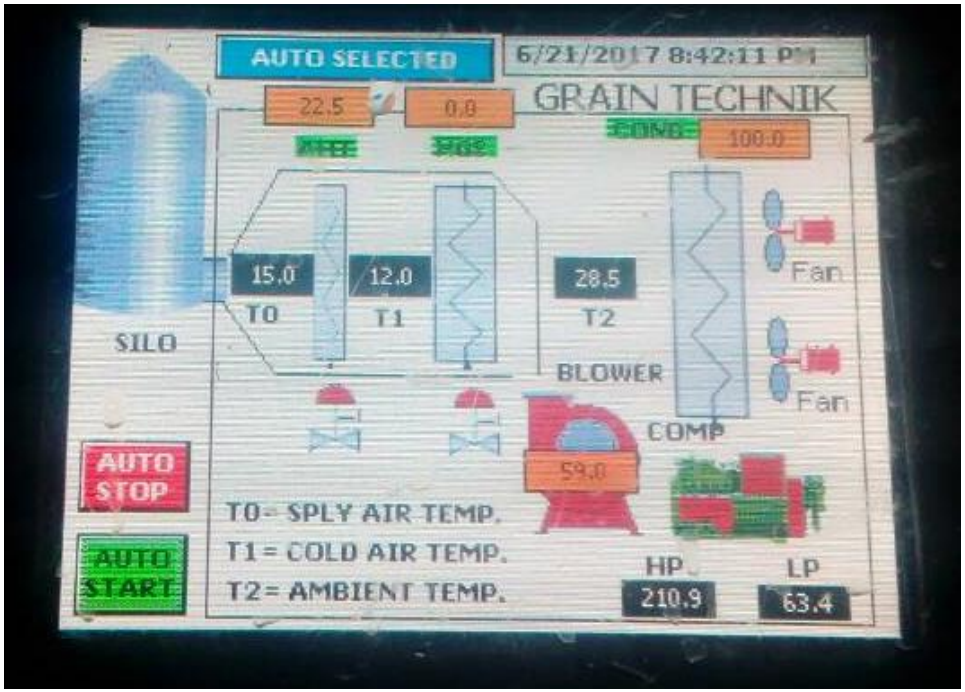

Storage of Maize for Poultry Feed

Installations

Storage of Maize

Installations

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Storage of Maize

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THANK YOU !!